

# Wireless display system, Method and Computer program medium therefor

## Field of the Invention

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Hitherto, when using input and output peripheral devices for PC (for example, barcode reader, tester, GPS) in a wireless display system, it is required to use a peripheral device built in the main body of data processing apparatus such as PC, or an external device connected to the general-purpose interface of the PC main body.

Or as disclosed in Japanese Laid-open Patent No. 2001-69141, by using a device for replacing the cable of the input and output peripheral device with wireless connection, the input and output peripheral device of wireless connection can be used together with the wireless display system.

In the case of the former prior art, the display and the PC must be carried at the same time. In the wireless display system, the PC can be operated by carrying the display only, or the anti-shock capability is high because only the display having no mechanical parts is carried, but such merits are sacrificed in this case. In the latter prior art, as compared with the former, the portable device is lighter in weight and anti-shock capability is higher, but plural devices must be carried, and it is not convenient. In

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The invention is devised in the light of the above problems.

A method of communication of wireless display system of the invention comprises the steps of:

(b) converting data format and protocol in wireless communication,

and

(c) processing input and output in a data processing device virtually as if data input and output processing were done directly.

Step (a) and step (b) are done at the image display device side, and step (c) is done at the data processing device side. All data relating to data  
5 input and output communicated between the image display device and data processing device is processed at step (b) and step(c), and is mutually transmitted and received.

A computer program recording medium for executing communications of wireless display system of the invention includes the  
10 programs for:

(a) entering and producing data in and from an image display device,

(b) converting data format and protocol in wireless communication, and

15 (c) processing input and output in a data processing device virtually as if data input and output processing were done directly.

Program (a) and program (b) are executed at the image display device side, and program (c) is executed at the data processing device side. All data relating to data input and output communicated between the  
20 image display device and data processing device is transmitted and received by execution of program (b) and program (c).

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a configuration of wireless display  
25 system of embodiment 1 of the invention.

Fig. 2 shows an appearance of wireless display system of embodiment 1 of the invention.

Fig. 3 is a flowchart showing power saving process in wireless display system of embodiment 1 of the invention.

Fig. 4 is a flowchart showing wireless communication process in wireless display system of embodiment 1 of the invention.

5 Fig. 5 shows an appearance of wireless display system of embodiment 2 of the invention.

Fig. 6 is a flowchart showing verification process in wireless display system of embodiment 2 of the invention.

10 Fig. 7 shows an appearance of wireless display system of embodiment 3 of the invention.

Fig. 8 shows an appearance of wireless display system of embodiment 4 of the invention.

Fig. 9 shows an appearance of wireless display system of embodiment 5 of the invention.

15 Fig. 10 shows an appearance of wireless display system of embodiment 6 of the invention.

Fig. 11 shows an appearance of wireless display system of embodiment 7 of the invention.

## 20 DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Embodiments of the invention are described below while referring to Fig. 1 to Fig. 11.

(Embodiment 1)

25 Fig. 1 is a block diagram showing a configuration of wireless display system of embodiment 1 of the invention.

Fig. 1 shows a data processing device 101 and an image display device 106. A CPU 102 is processing means of the data processing device

101. A memory 103 and an HDD 104 are both storing means of the data processing device 101. The memory 103 temporarily stores the code and processing data to be processed in the CPU 102, and the HDD 104 stores results of processing and other data for a long period. A wireless unit 105 is wireless communication means of the data processing device 101, and wireless communications are made with the image display device 106. In this embodiment, the technology of, for example, IEEE802.11 can be employed in wireless communications.

A CPU 107 is processing means of the image display device 106. A memory 108 and a flash memory 109 are both storing means of the image display device 106. The memory 108 temporarily stores the code and processing data to be processed in the CPU 107, and the flash memory 109 stores results of processing and other data for a long period. A wireless unit 110 is wireless communication means of the image display device 106, and wireless communications are made with the data processing device 101.

A touch panel 111 and an operation button 112 are both operating means of the image display device 106. The touch panel 111 is mainly responsible for input of operation depending on coordinates, among various operations of the PC. The operation button 112 is used for operation input for fixing and establishing the input, or calling of original function incorporated in the image display device. An LCD 113 is display means of the image display device 106, and it receives and displays the image transmitted by the data processing device 101 through wireless communication, or displays the image created by the image display device 106 itself. A serial port 114 is data input and output means of the image display device 106, and data is exchanged with a serial device connected to

the port. In this embodiment, for example, the technology conforming to RS-232-C may be employed in serial communication.

In the embodiment of the invention, the input and output processing virtual means is realized by a program stored in the memory 103  
5 of the data processing device 101 and executed by the CPU 102. For example, when the code to be executed by the CPU 102 of the data processing device 101 is composed of an operating system, and an application running on the operating system, the input and output processing virtual means is realized by a driver or resident application  
10 conforming to the specification of the operating system. The input and output processing virtual means operates when the general application requests serial communication process to the operating system. That is, the instruction for data output to the serial port or state change conforming to the specification of the operating system is converted into data format  
15 and protocol of wireless communication. In consequence, the data and protocol of wireless communication format are converted to the notice of data input from serial port or state change conforming to the specification of the operating system. In this way, the input and output processing virtual means processes input and output virtually. In this embodiment, the  
20 technology of TCP/IP protocol may be employed for data format and protocol of wireless communication.

The input and output data converting means and power saving control means are realized by programs stored in the memory 108 of the image display device 106, and executed by the CPU 107. By input and  
25 output data converting means, the input data and state change information of the serial port 114 are converted into the data format and protocol of wireless communication, and the data and protocol of wireless

communication format received in the wireless unit 110 are converted into the output data and state change instruction of the serial port 114. The power saving control means can change the power saving setting and control on/off switching of power supply of the CPU 107, wireless unit 110,  
5 touch panel 111, and LCD 113 individually.

After completion of wireless communication connection between the data processing device 101 and image display device 106, if there is any data input from the serial port 114 or state change such as signal wire change of serial port 114, the image display device 106 converts the serial  
10 data and signal wire change to the data format and protocol of wireless communication by the program on the CPU 107, and transmits to the data processing device 101 from the wireless unit 110. The data processing device 101 receives the transmitted input data of wireless communication format in the wireless unit 105. The input data is, by the CPU 102,  
15 returned from the data and protocol of wireless communication format to the original serial data and code showing the state change such as signal wire change by the input and output processing virtual program, and is handled by other program on the CPU 102. As a result, the serial input through wireless communication can be processed similarly with the serial  
20 input from the serial port incorporated in the data processing device 101.

In the case the processing result of serial input brings about a change on the display screen, the CPU 102 of the data processing device 101 creates display screen image data on the basis of the serial input data processing result. The CPU 102 transmits the differential portion or  
25 whole of screen image from the wireless unit 105 to the image display device 106. The image display device 106 displays the transmitted display screen image data in the LCD 113.

After completion of wireless communication connection between the data processing device 101 and image display device 106, if there is output data to the serial port 114 or state change instruction such as signal wire change of serial port 114, by various programs operating on the CPU 102 of the data processing device 101, the data processing device 101 starts output processing same as the serial data from the incorporated serial port. Its output processing is done through the input and output virtual program on the CPU 102. As a result, the serial output data and state change instruction such as signal wire change are converted to the data format and protocol of wireless communication, and transmitted to the image display device 106 from the wireless unit 105. The image display device 106 receives the transmitted serial output data and state change instruction such as serial signal wire change being converted to the data format and protocol of wireless communication, in the wireless unit 105. The input and output data conversion program on the CPU 107 returns the data and protocol of wireless communication format to the original serial output data and state change instruction such as serial signal wire change, and executes output to the serial port 114 or state change such as signal wire change.

As a result of transmission of serial output data, if the display screen is changed, the CPU 102 of the data processing device 101 creates display screen image data on the basis of the serial output data processing result, and transmits the differential portion or whole of screen image from the wireless unit 105 to the image display device 106. The image display device 106 displays the transmitted display screen image data in the LCD 113.

Fig. 2 shows an appearance of the wireless display system in





100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088 1089 1090 1091 1092 1093 1094 1095 1096 1097 1098

Fig. 4 is a flowchart showing wireless communication process of the wireless display system in embodiment 1 of the invention.

When wireless communication starts after completion of wireless  
20 connection between the data processing device 101 and image display  
device 106, the communication rate of the following data is measured at  
step 401. The data is the sum of all data of wireless communications, that  
is, the user's operation data entered through the touch panel 111 and  
operation button 112, the screen image data as a result of data processing  
25 by the data processing device 101 according to the user's operation and data  
input and output relating to the serial port 114, the input data from the  
serial port 114, and the output data to be issued by the data processing

(Embodiment 2)

Embodiment 2 differs from embodiment 1 in that a barcode reader incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, and wireless communication process are same as in embodiment 1, and duplicate explanation is omitted.

In Fig. 5, a PC main body 501 corresponds to the data processing  
 25 device, and a display 502, to the image display device. An LCD panel 503  
 is display means, a touch panel 504 and an operation button 505 are input  
 means, and a barcode reader 506 is data input and output means. In Fig.

5, the barcode reader 506 is connected to the display 502 through a cable, but it may be also incorporated in the display 502.

Fig. 6 is a flowchart showing validation process in wireless display system of embodiment 2 of the invention.

5 After starting the PC main body 501, the power source of the display 502 is turned on, and the barcode reader 506 connected to the display 502 is started to set in barcode reading state. At step 601, the user, using the barcode reader 506, reads the barcode of the object printing the barcode for identifying the user such as the ID plate. At step 602, from the  
10 reading result, the password for verifying connection and the user ID and password for verifying the user are acquired.

In the embodiment, in order to acquire the password for verifying connection and the user ID and password for authenticating the user, a table for acquiring the password for verifying connection and the user ID  
15 and password for authenticating the user from the data being read by the barcode reader 506 is preliminarily stored in the storage means of the display 502. Aside from this method of referring to the table by the data of reading result, there is also a method of taking out the password for verifying connection and the user ID and password for authenticating the  
20 user contained in the reading result data directly from the reading result data.

When the password for verifying connection and the user ID and password for authenticating the user are acquired, at step 603, wireless connection process between the display 502 and PC main body 501 is  
25 started. Once wireless connection process is started, at step 604, wireless connection is verified by using the password for verification of wireless connection. For verification of wireless connection, a general verification

method may be used, such as verification of coincidence of the acquired password for verification of wireless connection and password stored at the PC main body 501 side. At step 605, the verification result is confirmed, and if failing in verification of wireless connection, the wireless connection process is stopped at step 609. When succeeding in wireless connection verification, next, the user ID and password for user authentication are transmitted to the PC main body 501 by wireless communication, and the user is authenticated by the PC main body 501. If failing in user authentication at step 607, the wireless connection process is stopped at step 609. When succeeding in user authentication, at step 608, the operating environment of the PC main body 501 depending on the user ID is reproduced, and the wireless connection process is completed. After step 608, ordinary wireless communication is enabled.

(Embodiment 3)

Embodiment 3 of the invention is explained while referring to Fig. 7.

Embodiment 3 differs from embodiment 1 in that a tester incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, and wireless communication process are same as in embodiment 1, and duplicate explanation is omitted.

Fig. 7 shows an appearance of wireless display system of embodiment 3 of the invention.

In Fig. 7, a PC main body 701 corresponds to the data processing device, and a display 702, to the image display device. An LCD panel 703 is display means, a touch panel 704 and an operation button 705 are input means, and a tester 706 is data input and output means. In Fig. 7, the

(Embodiment 4)

5 8.

Fig. 8 shows an appearance of wireless display system of embodiment 4 of the invention.

In Fig. 8, a PC main body 801 corresponds to the data processing device, and a display 802, to the image display device. An LCD panel 803 is display means, a touch panel 804 and an operation button 805 are input means, and a digital camera 806 is data input and output means. In Fig. 8, the digital camera 806 is connected to the display 802 through a cable, but it may be also incorporated in the display 802.

## 20 (Embodiment 5)

9.

duplicate explanation is omitted.

Fig. 9 shows an appearance of wireless display system of embodiment 5 of the invention.

In Fig. 9, a PC main body 901 corresponds to the data processing  
5 device, and a display 902, to the image display device. An LCD panel 903  
is display means, a touch panel 904 and an operation button 905 are input  
means, and a card reader 906 is data input and output means. In Fig. 9,  
the card reader 906 is connected to the display 902 through a cable, but it  
may be also incorporated in the display 902.

10 (Embodiment 6)

Embodiment 6 of the invention is explained while referring to Fig. 10.

Embodiment 6 differs from embodiment 2 in that a scanner incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, wireless communication process, and verification process are same as in embodiment 2, and duplicate explanation is omitted.

Fig. 10 shows an appearance of wireless display system of  
20 embodiment 6 of the invention.

In Fig. 10, a PC main body 1001 corresponds to the data processing device, and a display 1002, to the image display device. An LCD panel 1003 is display means, a touch panel 1004 and an operation button 1005 are input means, and a scanner 1006 is data input and output means. In Fig. 10, the scanner 1006 is connected to the display 1002 through a cable, but it may be also incorporated in the display 1002.

(Embodiment 7)

Embodiment 7 of the invention is explained while referring to Fig. 11.

Embodiment 7 differs from embodiment 1 in that a GPS receiver incorporated or externally provided in the display of the wireless display is used as data input and output means. The other configuration, data input and output processing, power saving process, and wireless communication process are same as in embodiment 1, and duplicate explanation is omitted.

Fig. 11 shows an appearance of wireless display system of embodiment 7 of the invention.

In Fig. 11, a PC main body 1101 corresponds to the data processing device, and a display 1102, to the image display device. An LCD panel 1103 is display means, a touch panel 1104 and an operation button 1105 are input means, and a GPS receiver 1106 is data input and output means. In Fig. 11, the GPS receiver 1106 is connected to the display 1102 through a cable, but it may be also incorporated in the display 1106.

Herein, the wireless display system and its communication method of the invention are specifically described by referring to embodiments. According to the invention, the input and output peripheral devices can be used at the displays side of the wireless display. Further, the display  
20 function and the input and output peripheral device function cooperate, so that power saving control, easy connection, and verification sequence can be realized.

The program recording medium of the invention has recorded the program for the computer to execute this communication method.